**STEPS OF MARKET SEGMENTATION ANALYSIS**

**Step 1: Deciding (not) to Segment**

Market segmentation is a strategic approach that involves dividing a broad target market into smaller, more homogeneous groups based on certain characteristics or behaviors. This process allows businesses to tailor their marketing efforts to specific segments, recognizing that one-size-fits-all approaches may not be as effective in today's diverse and dynamic marketplace. Committing to market segmentation has various implications for businesses, influencing their marketing strategies, product development, and overall competitiveness. Moreover, committing to market segmentation allows for more efficient resource allocation. Rather than allocating resources broadly across the entire market, companies can focus their efforts on the segments that are most likely to yield the highest returns. This targeted approach helps optimize marketing budgets, reduce wastage, and improve the overall return on investment. Businesses can tailor their promotional efforts to resonate with the unique characteristics and preferences of each segment, maximizing the impact of their marketing campaigns.

Potentially required changes include the development of new products, the modification of existing products, changes in pricing and distribution channels used to sell the product, as well as all communications with the market. These changes, in turn, are likely to influence the internal structure of the organisation, which may need to be adjusted in view of, for example, targeting a handful of different market segments.

Implementation Barriers

The first group of barriers relates to senior management. Lack of leadership, pro-active championing, commitment and involvement in the market segmentation process by senior leadership undermines the success of market segmentation. As McDonald and Dunbar (1995, p. 158) state: There can be no doubt that unless the chief executive sees the need for a segmentation review, understands the process and shows an active interest in it, it is virtually impossible for a senior marketing executive to implement the conclusions in a meaningful way.

A second group of barriers relates to organisational culture. Lack of market or consumer orientation, resistance to change and new ideas, lack of creative thinking, bad communication and lack of sharing of information and insights across organisational units, short-term thinking, unwillingness to make changes and office politics have been identified as preventing the successful implementation of market segmentation (Dibb and Simkin 2008). Croft (1994) developed a short questionnaire to assess the extent to which a lack of market orientation in the organisational culture may represent a barrier to the successful implementation of market segmentation.

Step 1 Checklist

Deciding to segment a market involves a comprehensive checklist to ensure strategic alignment, efficient resource utilization, and successful implementation of targeted marketing approaches. Firstly, businesses must assess the overall market potential and identify distinct customer needs, behaviors and preferences, determining whether segmentation aligns with the company's goals and objectives. Analyzing the feasibility of obtaining accurate and relevant data is crucial, as successful segmentation relies on robust market research and data analytics capabilities. Another aspect of the checklist involves evaluating the flexibility of segmentation strategies to adapt to evolving market dynamics. Businesses must consider whether their segmentation approach allows for adjustments based on changing consumer behaviors and market trends. Moreover, assessing the potential for increased customer satisfaction and loyalty through targeted marketing efforts is essential, as this is a key goal of market segmentation.

In summary, the checklist for deciding to segment in market segmentation involves assessing market potential, competitive advantages, data analytics capabilities, flexibility in strategies, alignment with organizational goals, resource allocation efficiency, customer satisfaction potential, risk of alienation, and commitment to ongoing investments in technology and talent. By carefully considering these factors, businesses can make informed decisions about whether market segmentation aligns with their objectives and can be successfully implemented to enhance their competitiveness in the marketplace.

**Step 2: Specifying the Ideal Target Segment**

Segment Evaluation Criteria

The third layer of market segmentation analysis depends primarily on user input. It is important to understand that – for a market segmentation analysis to produce results that are useful to an organisation – user input cannot be limited to either a briefing at the start of the process, or the development of a marketing mix at the end. Rather, the user needs to be involved in most stages, literally wrapping around the technical aspects of market segmentation analysis.

Segment evaluation criteria play a pivotal role in the success of market segmentation strategies, encompassing a comprehensive set of factors that guide businesses in assessing the viability and potential of each identified segment. Firstly, the criterion of measurability is crucial, as segments should be quantifiable and accessible through identifiable characteristics or data points to facilitate effective targeting and evaluation of marketing efforts. The criterion of accessibility follows, focusing on the ease with which businesses can reach and engage with a specific segment. The evaluation should consider the availability of distribution channels, communication platforms, and other avenues that enable effective interaction with the targeted audience. Additionally, considering the segment's responsiveness to marketing efforts is essential, as segments that exhibit a higher likelihood of responding positively to tailored messages and campaigns contribute to a more efficient resource allocation.

In conclusion, the segment evaluation criteria provide a systematic framework for businesses to assess the suitability and potential of different market segments. By considering factors such as measurability, accessibility, responsiveness, substantiality, differentiation, actionability, sustainability, compatibility, profitability, data accessibility, adaptability, competition, and congruence, companies can make informed decisions about which segments to target and how to tailor their marketing strategies for optimal results in the dynamic and diverse marketplace.

Knock-Out Criteria

Knock-out criteria are used to determine if market segments resulting from the market segmentation analysis qualify to be assessed using segment attractiveness criteria. The first set of such criteria was suggested by Kotler (1994) and includes substantiality, measurability and accessibility (Tynan and Drayton 1987). Kotler himself and a number of other authors have since recommended additional criteria that fall into the knock-out criterion category (Wedel and Kamakura 2000; Lilien and Rangaswamy 2003; McDonald and Dunbar 2012): Knock-out criteria in market segmentation are essential filters that help businesses refine and prioritize their focus on specific segments, ensuring that only the most viable and strategically aligned segments are pursued. First and foremost, the criterion of alignment with business objectives stands out, requiring that a potential segment aligns with the company's overarching goals and mission to warrant further consideration, ensuring that efforts are in harmony with the organization's strategic direction. Market size and potential profitability emerge as central knock-out criteria, emphasizing the importance of pursuing segments with adequate size and purchasing power to justify the investment in targeted marketing efforts. Smaller, niche segments may be excluded if their limited scale does not align with the company's financial objectives or fails to offer substantial market share.

In conclusion, knock-out criteria are indispensable filters that guide businesses in selecting the most strategically sound and feasible market segments. By considering alignment with business objectives, feasibility, market size, competitive intensity, long-term sustainability, accessibility, measurability, legal and ethical considerations, and adaptability, companies can systematically eliminate less viable segments, allowing for a focused and effective approach to market segmentation in the ever-evolving business landscape

Attractiveness Criteria

Attractiveness criteria are not binary in nature. Segments are not assessed as either complying or not complying with attractiveness criteria. Rather, each market segment is rated; it can be more or less attractive with respect to a specific criterion. Attractiveness criteria in market segmentation serve as pivotal guidelines for businesses, aiding in the identification and prioritization of segments that offer the most promising opportunities. Foremost among these criteria is market growth potential, necessitating an assessment of whether a segment exhibits sustained growth trends that align with the company's objectives, ensuring that efforts are directed towards dynamic and expanding markets. The criterion of size and profitability emerges as a crucial factor, emphasizing the significance of pursuing segments that not only boast substantial market size but also present the potential for lucrative returns. Larger segments may offer economies of scale, while profitability considerations ensure that the company allocates resources efficiently to segments that contribute significantly to its financial success. The adaptability of a segment to changes in market dynamics and consumer behaviors is an essential attractiveness criterion. Segments that demonstrate flexibility and resilience, allowing for adjustments to marketing strategies over time, are considered more attractive for sustained success in the dynamic business environment

In conclusion, attractiveness criteria in market segmentation guide businesses in selecting segments that align with their strategic objectives and offer the most promising opportunities for success. By considering factors such as market growth potential, size and profitability, accessibility, competitive intensity, long-term sustainability, purchasing power, brand fit, synergy, innovation potential, and adaptability, companies can systematically identify and prioritize attractive segments, enabling a focused and effective approach to market segmentation in today's ever-changing business landscape.

Implementing a Structured Process

The most popular structured approach for evaluating market segments in view of selecting them as target markets is the use of a segment evaluation plot (Lilien and Rangaswamy 2003; McDonald and Dunbar 2012) showing segment attractiveness along one axis, and organisational competitiveness on the other axis. Factors which constitute both segment attractiveness and organisational competitiveness need to be negotiated and agreed upon. To achieve this, a large number of possible criteria has to be investigated before agreement is reached on which criteria are most important for the organisation.

Back to the segment evaluation plot. Obviously the segment evaluation plot cannot be completed in Step 2 of the market segmentation analysis because – at this point – no segments are available to assess yet. But there is a huge benefit in selecting the attractiveness criteria for market segments at this early stage in the process: knowing precisely what it is about market segments that matters to the organisation ensures that all of this information is captured when collecting data. Implementing a structured process in market segmentation involves a systematic and strategic approach to identifying, evaluating, and targeting specific customer segments. The first step in this process is thorough market research to gather relevant data and insights, providing a foundation for informed decision-making. Segmentation begins with defining clear and distinct criteria, determining which factors will be used to categorize and differentiate customer groups. This involves considering demographic, psychographic, behavioral, and geographic variables to create meaningful and relevant segments that align with the company's goals.

In conclusion, implementing a structured process in market segmentation involves rigorous research, defining clear criteria, segmenting the market, evaluating and prioritizing segments, tailoring marketing strategies, and maintaining adaptability through ongoing monitoring. Collaboration across departments is crucial to ensure a seamless and effective implementation that aligns with the company's overarching goals and enhances its competitiveness in the marketplace.

Step 2 Checklist

Specifying the ideal target segment in market segmentation involves a methodical checklist to identify and prioritize segments that align with the company's objectives. The first step is defining clear and specific criteria, encompassing demographic, psychographic, behavioral, and geographic factors, to create a detailed profile of the ideal customer. Once criteria are established, businesses must conduct comprehensive market research to gather relevant data and insights. This involves analyzing customer preferences, behaviors, and purchasing patterns to identify segments with the highest potential for success. Lastly, businesses should assess the fit between the ideal target segment and their brand image. Ensuring that the segment aligns with the company's values, messaging, and overall brand identity fosters authenticity and strengthens the connection with the target audience.

In conclusion, specifying the ideal target segment involves a comprehensive checklist encompassing criteria definition, thorough market research, assessment of size and growth potential, accessibility, competitive intensity, alignment with capabilities, consideration of purchasing power, and brand fit. A meticulous evaluation of these factors aids businesses in identifying and prioritizing segments that offer the greatest potential for success and align with their strategic objectives.

**Step 3: Collecting Data**

Segmentation Variables

the term segmentation variable to refer to the variable in the empirical data used in commonsense segmentation to split the sample into market segments. In commonsense segmentation, the segmentation variable is typically one single characteristic of the consumers in the sample. All the other personal characteristics available in the data – in this case: age, the number of vacations taken, and information about five benefits people seek or do not seek when they go on vacation – serve as so-called descriptor variables. They are used to describe the segments in detail. Describing segments is critical to being able to develop an effective marketing mix targeting the segment. Typical descriptor variables include socio-demographics, but also information about media behaviour, allowing marketers to reach their target segment with communication messages. Segmentation variables play a crucial role in the collection of data for marketing segmentation, providing businesses with a systematic approach to categorizing and understanding their diverse customer base. Demographic variables, such as age, gender, income, and education level, serve as foundational factors in collecting data, offering insights into the basic characteristics of the target audience and facilitating the creation of distinct customer segments based on demographic similarities. Psychographic variables delve into the attitudes, values, lifestyles, and personalities of customers, offering a deeper understanding of their motivations and preferences. By collecting data on psychographic variables, businesses can identify shared interests, values, and behaviors within specific segments, enabling more targeted and personalized marketing strategies.

In conclusion, segmentation variables are diverse factors that businesses use to collect data for marketing segmentation. By considering demographic, psychographic, behavioral, geographic, firmographic, technographic, life stage, attitudinal, social and cultural, and environmental variables, businesses can create meaningful and targeted segments that align with the diverse characteristics and preferences of their customer base. The systematic collection and analysis of data on these variables empower businesses to tailor their marketing strategies, enhance customer engagement, and ultimately drive success in the dynamic and competitive marketplace.

Segmentation Criteria

The term segmentation criterion is used here in a broader sense than the term segmentation variable. The term segmentation variable refers to one measured value, for example, one item in a survey, or one observed expenditure category. The term segmentation criterion relates to the nature of the information used for market segmentation. It can also relate to one specific construct, such as benefits sought. The decision which segmentation criterion to use cannot easily be outsourced to either a consultant or a data analyst because it requires prior knowledge about the market. The most common segmentation criteria are geographic, sociodemographic, psychographic and behavioural. Segmentation criteria in data collection for marketing segmentation are essential parameters that businesses use to categorize and differentiate their target audience. These criteria help in creating distinct consumer segments, allowing for tailored marketing strategies. Demographic variables, such as age, gender, income, and education, provide foundational data, offering insights into the basic characteristics of the target market. Geographic variables, such as location and climate, assist in understanding regional preferences and tailoring marketing efforts accordingly. Psychographic criteria delve into the lifestyle, values, and attitudes of consumers, allowing for more personalized and emotionally resonant marketing strategies.

Technology adoption criteria focus on understanding how consumers embrace new technologies, aiding businesses in staying innovative and targeting tech-savvy segments effectively. By strategically collecting and analyzing data based on these segmentation criteria, businesses can develop targeted marketing strategies that resonate with specific consumer segments, ultimately enhancing customer satisfaction and driving business success.

Geographic Segmentation

The key advantage of geographic segmentation is that each consumer can easily be assigned to a geographic unit. As a consequence, it is easy to target communication messages, and select communication channels (such as local newspapers, local radio and TV stations) to reach the selected geographic segments. The key disadvantage is that living in the same country or area does not necessarily mean that people share other characteristics relevant to marketers, such as benefits they seek when purchasing a product. While, for example, people residing in luxury suburbs may all be a good target market for luxury cars, location is rarely the reason for differences in product preference. Even in the case of luxury suburbs, it is more likely that socio-demographic criteria are the reason for both similar choice of suburb to live in and similar car preferences. The typical case is best illustrated using tourism: people from the same country of origin are likely to have a wide range of different ideal holidays, depending on whether they are single or travel as a family, whether they are into sports or culture.

Socio-Demographic Segmentation

Typical socio-demographic segmentation criteria include age, gender, income and education. Socio-demographic segments can be very useful in some industries. For example: luxury goods (associated with high income), cosmetics (associated with gender; even in times where men are targeted, the female and male segments are treated distinctly differently), baby products (associated with gender), retirement villages (associated with age), tourism resort products (associated with having small children or not).

Psychographic Segmentation

Psychographic criteria are, by nature, more complex than geographic or sociodemographic criteria because it is difficult to find a single characteristic of a person that will provide insight into the psychographic dimension of interest. As a consequence, most psychographic segmentation studies use a number of segmentation variables, for example: a number of different travel motives, a number of perceived risks when going on vacation. The psychographic approach has the advantage that it is generally more reflective of the underlying reasons for differences in consumer behaviour. For example, tourists whose primary motivation to go on vacation is to learn about other cultures, have a high likelihood of undertaking a cultural holiday at a destination that has ample cultural treasures for them to explore

Behavioural Segmentation

Another approach to segment extraction is to search directly for similarities in behaviour or reported behaviour. A wide range of possible behaviours can be used for this purpose, including prior experience with the product, frequency of purchase, amount spent on purchasing the product on each occasion (or across multiple purchase occasions), and information search behaviour. But behavioural data is not always readily available, especially if the aim is to include in the segmentation analysis potential customers who have not previously purchased the product, rather than limiting oneself to the study of existing customers of the organisation

Data from Survey Studies

But survey data – as opposed to data obtained from observing actual behaviour – can be contaminated by a wide range of biases. Such biases can, in turn, negatively affect the quality of solutions derived from market segmentation analysis. Data from survey studies in marketing segmentation is invaluable for businesses seeking to understand consumer preferences, behaviors, and characteristics. Surveys, as a primary data collection method, provide a systematic and structured approach to gathering information directly from target audiences. In survey studies, businesses design questionnaires that encompass a range of relevant topics, including demographics, psychographics, purchasing behaviors, and product preferences. The collected data allows companies to create detailed consumer profiles and identify distinct segments within their target market.

In conclusion, data from survey studies is a rich source of information for marketing segmentation. It empowers businesses to create targeted strategies by gaining insights into demographics, psychographics, purchasing behaviors, and customer satisfaction. Utilizing survey data enables companies to enhance their understanding of their target market, refine their marketing approaches, and ultimately drive success in a competitive business landscape.

Choice of Variables

Noisy variables do not contribute any information necessary for the identification of the correct market segments. Instead, their presence makes it more difficult for the algorithm to extract the correct solution. Noisy variables can result from not carefully developing survey questions, or from not carefully selecting segmentation variables from among the available survey items. The problem of noisy variables negatively affecting the segmentation solution can be avoided at the data collection and the variable selection stage of market segmentation analysis. Developing a good questionnaire typically requires conducting exploratory or qualitative research. Exploratory research offers insights about people’s beliefs that survey research cannot offer. These insights can then be categorised and included in a questionnaire as a list of answer options. Such a two-stage process involving both qualitative, exploratory and quantitative survey research ensures that no critically important variables are omitted.

Response Options

Options allowing respondents to answer in only one of two ways, generate binary or dichotomous data. Such responses can be represented in a data set by 0s and 1s. The distance between 0 and 1 is clearly defined and, as such, poses no difficulties for subsequent segmentation analysis. Options allowing respondents to select an answer from a range of unordered categories correspond to nominal variables. If asked about their occupation, repondents can select only one option from a list of unordered options. Nominal variables can be transformed into binary data by introducing a binary variable for each of the answer options. binary or metric response options prevents subsequent complications relating to the distance measure in the process of data-driven segmentation analysis. Although ordinal scales dominate both market research and academic survey research, using binary or metric response options instead is usually not a compromise. If, for example, there is a strong reason to believe that very fine nuances of responses need to be captured, and if capturing those fine nuances does not come at the cost of also capturing response styles, this can be achieved using visual analogue scales.

Response Styles

wide range of response styles manifest in survey answers, including respondents’ tendencies to use extreme answer options (STRONGLY AGREE, STRONGLY DISAGREE), to use the midpoint (NEITHER AGREE NOR DISAGREE), and to agree with all statements. Response styles affect segmentation results because commonly used segment extraction algorithms cannot differentiate between a data entry reflecting the respondent’s belief from a data entry reflecting both a respondent’s belief and a response style. For example, some respondents displaying an acquiescence bias (a tendency to agree with all questions) could result in one market segment having much higher than average agreement with all answers. Such a segment could be misinterpreted. Imagine a market segmentation based on responses to a series questions asking tourists to indicate whether or not they spent money on certain aspects of their vacation, including DINING OUT, VISITING THEME PARKS, USING PUBLIC TRANSPORT, etc. A market segment saying YES to all those items would, no doubt, appear to be highly attractive for a tourist destination holding the promise of the existence of a high-spending tourist segment. It could equally well just reflect a response style. It is critical, therefore, to minimise the risk of capturing response styles when data is collected for the purpose of market segmentation. In cases where attractive market segments emerge with response patterns potentially caused by a response style, additional analyses are required to exclude this possibility. Alternatively, respondents affected by such a response style must be removed before choosing to target such a market segment.

Sample Size

Many statistical analyses are accompanied by sample size recommendations. Not so market segmentation analysis. illustrates the problem any segmentation algorithm faces if the sample is insufficient. The market segmentation problem in this figure is extremely simple because only two segmentation variables are used. Yet, when the sample size is insufficient (left plot), it is impossible to determine which the correct number of market segments is. If the sample size is sufficient, however (right plot) it is very easy to determine the number and nature of segments in the data set. The adjusted Rand index serves as the measure of correctness of segment recovery. The adjusted Rand index assesses the congruence between two segmentation solutions. Higher values indicate better alignment. Its maximum possible value is 1. The expected value is 0 if the two segmentation solutions are derived independently in a random way. To assess segment recovery, the adjusted Rand index is calculated for the true segment solution and the extracted one. If the variables are not correlated at all, the algorithm has no difficulty extracting the correct segments. If, however, the variables are highly correlated, the task becomes so difficult for the algorithm, that even increasing the sample size dramatically does not help. A small number of noisy variables, on the other hand, has a lower effect.

Data from Internal Sources

Data from internal sources is a valuable asset for marketing segmentation, offering insights derived from a company's own records and operations. Customer Relationship Management (CRM) systems serve as a primary internal source, providing detailed information on customer interactions, transactions, and preferences. Sales data, including purchase history and patterns, aids in identifying high-value customers and tailoring strategies to enhance their satisfaction and loyalty. Internal sources also encompass customer service records, offering valuable insights into common issues, concerns, and feedback, which can inform segmentation strategies to address specific customer needs. Analyzing website analytics and online interactions provides data on customer behavior, allowing businesses to understand preferences, navigation patterns, and areas of interest. Internal sources extend to inventory management systems, helping identify product performance, popular items, and potential cross-selling opportunities. Employee feedback and insights from frontline staff can offer qualitative data on customer interactions, helping refine segmentation based on real-world observations and experiences.

Utilizing internal financial data enables businesses to assess the profitability of different customer segments, ensuring that marketing efforts are aligned with revenue generation goals. Internal data also includes information on past marketing campaigns, allowing for an evaluation of their effectiveness and guiding future segmentation strategies. Integrating data from various internal sources provides a holistic view of customer behavior, preferences, and business operations, enabling companies to create targeted and efficient marketing segmentation strategies that enhance customer satisfaction and drive business growth.

Data from Experimental Studies

Experimental data can also result from choice experiments or conjoint analyses. The aim of such studies is to present consumers with carefully developed stimuli consisting of specific levels of specific product attributes. Consumers then indicate which of the products – characterised by different combinations of attribute levels – they prefer. Conjoint studies and choice experiments result in information about the extent to which each attribute and attribute level affects choice. This information can also be used as a segmentation criterion

Data from experimental studies in marketing segmentation involves conducting controlled experiments to gather insights into consumer behavior and preferences. These studies typically use randomized trials or controlled interventions to test specific variables and their impact on consumer responses. A key aspect of experimental studies is the ability to establish causation, providing a deeper understanding of how changes in marketing variables directly influence consumer outcomes. In experimental studies, businesses can manipulate various marketing elements, such as pricing, product features, or promotional strategies, to observe their effects on consumer behavior. By isolating these variables, researchers can draw more definitive conclusions about the cause-and-effect relationships between marketing actions and consumer responses.

In conclusion, data from experimental studies in marketing segmentation provides a rigorous and controlled approach to understanding consumer behavior. Through randomized trials and controlled interventions, businesses can gain valuable insights into the causal relationships between marketing variables and consumer responses, ultimately informing more effective segmentation strategies and improving overall marketing effectiveness

Step 3 Checklist

Creating an effective marketing segmentation strategy involves a comprehensive checklist for collecting relevant data, ensuring a thorough understanding of the target audience and facilitating the development of tailored marketing approaches. Initially, defining clear segmentation criteria is essential, encompassing demographic factors, geographic variables, psychographic insights, and behavioral patterns to create a detailed profile of the ideal customer. Conducting extensive market research follows, involving the gathering of quantitative and qualitative data to discern consumer preferences, behaviors, and purchasing patterns, providing a foundation for informed decision-making.

Ensuring the compatibility of segments with the organization's capabilities and resources is imperative, enabling the company to efficiently customize products, services, and marketing strategies. The checklist incorporates an evaluation of the purchasing power of the target audience, ensuring that efforts are directed towards segments with the financial capacity for significant transactions. Additionally, assessing the fit between the ideal target segment and the company's brand image is vital, fostering authenticity and resonance with the target audience.

Conducting a thorough analysis of the decision-making process, including factors such as occasion-based segmentation and social and cultural influences, enhances the precision of marketing strategies. Technological adoption criteria help companies stay innovative, targeting tech-savvy segments effectively. Finally, regular monitoring and adaptation based on ongoing data analysis ensure that segmentation strategies remain relevant in the dynamic business landscape, maintaining a focus on customer satisfaction and driving overall success.

CASE STUDY ON FOOD

CONVERSION OF R CODE TO PYTHON

import pandas as pd

# Load the data

mcdonalds = pd.read\_csv("https://raw.githubusercontent.com/biostat-bc/MSA/master/data/mcdonalds.csv")

# Display column names

print(mcdonalds.columns)

# Display dimensions

print(mcdonalds.shape)

# Display the first 3 rows

print(mcdonalds.head(3))

import pandas as pd

import numpy as np

# Load the data

mcdonalds = pd.read\_csv("https://raw.githubusercontent.com/biostat-bc/MSA/master/data/mcdonalds.csv")

# Select columns 1 to 11 and convert to matrix

MD\_x = mcdonalds.iloc[:, 0:11].values

# Convert "Yes" to 1 and "No" to 0

MD\_x = (MD\_x == "Yes").astype(int)

# Calculate column means and round to 2 decimal places

col\_means = np.round(np.mean(MD\_x, axis=0), 2)

# Display results

print(col\_means)

import pandas as pd

from sklearn.decomposition import PCA

# Load the data

mcdonalds = pd.read\_csv("https://raw.githubusercontent.com/biostat-bc/MSA/master/data/mcdonalds.csv")

# Select columns 1 to 11 and convert to matrix

MD\_x = mcdonalds.iloc[:, 0:11].values

# Convert "Yes" to 1 and "No" to 0

MD\_x = (MD\_x == "Yes").astype(int)

# Perform PCA

MD\_pca = PCA()

MD\_pca.fit(MD\_x)

# Display summary

print("Importance of components:")

print(pd.DataFrame({

'Standard deviation': MD\_pca.explained\_variance\_,

'Proportion of Variance': MD\_pca.explained\_variance\_ratio\_,

'Cumulative Proportion': np.cumsum(MD\_pca.explained\_variance\_ratio\_)

}, index=[f'PC{i+1}' for i in range(MD\_pca.n\_components\_)]))

Results from principal components analysis indicate that the first two components capture about 50% of the information contained in the segmentation variables. The following command returns the factor loadings:

import pandas as pd

from sklearn.decomposition import PCA

# Load the data

mcdonalds = pd.read\_csv("https://raw.githubusercontent.com/biostat-bc/MSA/master/data/mcdonalds.csv")

# Select columns 1 to 11 and convert to matrix

MD\_x = mcdonalds.iloc[:, 0:11].values

# Convert "Yes" to 1 and "No" to 0

MD\_x = (MD\_x == "Yes").astype(int)

# Perform PCA

MD\_pca = PCA()

MD\_pca.fit(MD\_x)

# Display standard deviations

print("Standard deviations (1, .., p=11):")

print(np.round(MD\_pca.explained\_variance\_, 1))

# Display rotation matrix

print("Rotation (n x k) = (11 x 11):")

print(pd.DataFrame(np.round(MD\_pca.components\_, 2), columns=[f'PC{i+1}' for i in range(MD\_pca.n\_components\_)], index=mcdonalds.columns[0:11]))